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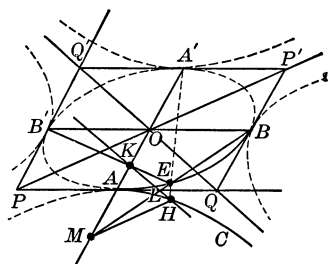
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If we add to the two sides of (1) the corresponding sides of (3) multiplied by m , we obtain $(1+m)(x/a) + (1-m)y/b = 1-m$, the equation of a straight line through H . The same process applied to (2) and (4) yields the *same* equation and, since the point $(0, b)$ satisfies the new equation, we see that H, E , and A' lie on this straight line.

Note.—A geometrical solution may be given. Starting with a square we easily find as loci, a circle and two conjugate equilateral hyperbolas. Then, by projection, we derive the loci found above. By the theorem of Meneläus we prove that the correlative points E, H , and A' are collinear, a property preserved in projection.

II. SOLUTION BY OTTO DUNKEL, Washington University.

The ranges of points K and L are projective and hence E is the intersection of two projective pencils with centers at B' and B , such that $B'B$ is not self-corresponding. It thus follows that the locus of E is a conic tangent at B' and B and passing through A and A' of the sides of the parallelogram. By using A and A' as centers it will be seen that it is tangent to the other two sides PQ and $P'Q'$. Similarly, the range of points M is projective with the ranges L and K , and hence H is the intersection of two pencils with centers at the points at infinity on OQ and OP . Thus the locus of H is a conic with OQ and OP as asymptotes, and the conic passes through A and A' . It may be shown by the theory of conics (analytic or projective theory) that PQ is a tangent. It also follows that the pencils A' (E) and A' (H) are projective, that $A'A, A'B, A'B'$ are self-corresponding rays of these two pencils and hence all the corresponding rays coincide. Therefore, A', E, H lie on a straight line, etc.



2757 [1919, 124]. Proposed by E. P. LANE, Rice Institute, Houston, Texas.

Integrate by quadrature the differential equation

$$\frac{d^2y}{dx^2} - 3y \frac{dy}{dx} + y^3 = 0.$$

SOLUTION BY ALEXANDER DILLINGHAM, U. S. Naval Academy.

Interchanging the variables and setting $q = dx/dy$, we have $d^2y/dx^2 = -(dq/dy)/q^3$. The given equation becomes, after making these substitutions,

$$\frac{dq}{dy} + 3yq^2 - y^3q^3 = 0.$$

By inspection we find a particular integral $q_1 = y^{-2}$ and hence we are led to put $q = q_1 + v$, where v is a function of y . The equation (1) now becomes a Bernoulli equation $dv/dy + 3v/y = v^3/y^3$ which reduces, on putting $z = v^{-2}$, to the linear equation $dz/dy - 6z/y = -2y^3$ with the integrating factor y^{-6} . We then obtain $zy^{-6} = \int (-2y^{-3})dy = y^{-2} + c_1$ or $z = y^4 + c_1y^6 = v^{-2}$. Hence we have in turn

$$v = \pm \frac{1}{y^2 \sqrt{1 + c_1 y^2}}, \quad q = \frac{1}{y^2} \pm \frac{1}{y^2 \sqrt{1 + c_1 y^2}} = \frac{dx}{dy},$$

and by integrating the last equation, we have finally

$$x = -\frac{1}{y} \mp \sqrt{y^{-2} + c_1} + c_2.$$

Also solved by R. D. BOHANNAN, P. J. DA CUNHA, E. B. ESCOTT, M. GUTTEN, H. HALPERIN, H. L. OLSON, and ELIJAH SWIFT.